STABILIZATION OF HIGH Tc PHASE IN BISMUTH CUPRATE SUPERCONDUCTOR BY LEAD DOPING

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ABSTRACT

It has widely been ascertained that doping of lead in Bi:Sr:Ca:Cu:O systems promotes the growth of high Tc (110 K) phase, improves critical current density, and lowers processing temperature. A systematic investigation is undertaken in the present study to determine optimum lead content and processing conditions to achieve these.

A large number of samples with cationic compositions of $Bi_{2-x}Pb_xSr_2Ca_2Cu_3$ (x=0.2 to 2.0) were prepared by conventional solid-state reaction technique. Samples of all compositions were annealed together at a temperature and characterized through resistance-temperature (R-T) measurements and X-ray diffraction (XRD) to determine the zero resistance temperature, Tc(0) and to identify presence of phases, respectively. The annealing temperature was varied between 790°C and 880°C to optimize processing parameters.

For x value between 0.3 to 0.8, Tc(0) above 110 K is obtained when the samples were annealed at a temperature in the range of 855°C to 870°C for 40 hours. The best samples showed Tc(0)=113 K and critical current density of about $200A/cm^2$. An optimum process yielded a large volume fraction of high Tc phase as determined from intensity peaks in XRD spectra. These results were supported through magnetic susceptibility measurements on samples having high Tc(0) values. The samples showed no change in R-T characteristics on repeated thermal cycling between 77 K and 300 K, even after a few weeks of their preparation.

In brief, we report an optimum process and composition of leaded bismuth cuprate superconductor which yields nearly a high Tc single phase with highly stable superconducting properties.